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Urban property around a planned casino site in Windsor, Ontario, 1975-1993.

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Urban Property Around a Planned Casino Site in Windsor, Ontario, 1975-93

by

John P. Lowrie

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Urban Property Around a Planned Casino Site
in Windsor, Ontario, 1975-93

ABSTRACT

This is a baseline study of the property sales and their values within the neighbourhood of a planned casino site in downtown Windsor, Ontario, Canada. Even preceding the official announcement of the permanent casino location near the Glengarry neighbourhood during January 1993, any predictable changes in the numbers of sales, property values, and owner-concentration might signify the beginnings of property re-evaluation and land-use alteration. The data set for the study consists of 1,344 residential, and 65 commercial transactions of 608 properties during the period from 1975 to 1993. Three measurements of property alteration are analyzed: (1) the monthly numbers of residential and commercial property sales; (2) the sale prices of these properties; and (3) the identification of the purchasers. ARIMA (Autoregressive Integrated Moving Average) modelling suggests that the monthly numbers of sales have decreased, but the property prices have increased, since the casino location announcement. Analysis of the purchaser names did not identify any significant land assembly within the study area.

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1.0 INTRODUCTION

The location of a permanent casino along the eastern boundary of downtown Windsor, Ontario, Canada, was announced during January 1993 (Windsor Star (The), 1993, January 15). This location was not predicted before its announcement, and thus owners and purchasers of properties within the surrounding neighbourhood probably did not anticipate this designation. Between 1993 and 1996, during the construction and opening of the permanent casino, property within this neighbourhood may be under pressure for significant alteration in utilization and value. This may be caused by (1) design and functional incompatibilities with neighbourhood housing, (2) congestion from the additional traffic and people, and (3) indirect demands for nearby services and housing (Rubenstein, 1984). While initially these factors may deflate property prices for residential uses, and even some commercial uses, the reactions of developers and property owners in the market may quickly stimulate increased transactions in property, with associated higher prices, and possibly concentrated, institutional ownership. In other words, the processes of neighbourhood commercial and residential intensification, de-intensification, and redevelopment are likely to be associated with property changing hands (Brooks, Jones and Phipps, 1994).

In order to measure the magnitude of the impacts after the construction of the permanent casino, this is a baseline study of the trends in property around the location of this planned casino during the years from 1975 to 1994. Three measurements of property alteration are analyzed: (1) the monthly numbers of residential and commercial property sales; (2) the sale prices of these properties; and (3) the identification of the purchasers. The trends in these measures are modelled as time series in order to represent the trends in recent property sales and thus tc project future trends in the absence of the permanent casino.

Two data sets are utilized in this study. First, the property sales data for the study area were collected from *Teela* real estate records. These records list the actual sale price, location, lot size, and name of the individual or company that has purchased a property. Therefore, a 'same name' search for companies or individuals who own significant holdings within the study area is possible. Second, a data set produced by the *Windsor-Essex Real Estate Board* and the *Canada Mortgage and Housing Corporation* is used to compare the property sales and prices within the study area with those in the entire county. This data set is composed of the numbers of monthly sales, and average monthly residential sale prices for houses located in Windsor and Essex County.

2.0 THEORY

Harvey (1973, p. 57) states that "the activity of any one element in an urban system may generate certain unpriced effects upon other elements in that system, known as externalities." Within every city there are numerous services and amenities that have resultant externalities. These externalities generally have a tapering effect, where the greatest impacts are located closest to the source (Hughes and Sirmans, 1992; Nelson et al., 1992; Thibodeau, 1990). Externalities may have positive and/or negative effects.

Urban casinos are one example of the new, large-scale, private and public facilities being located in inner-urban neighbourhoods since the mid 1970s. These office, retail, recreational and service facilities have economic, city-wide development purposes (Feagin, 1987). More locally, they generate both positive and negative externalities that especially affect the values of neighbouring properties (Hughes and Sirmans, 1992; Nelson et al., 1992; Thibodeau, 1990). On the one hand, these may help economically to revitalize inner-urban neighbourhoods, if deteriorating housing is either gentrified for upper-income households, or intensified for middle-income workers, or converted to commercial uses (Beauregard, 1990). On the other hand, however, these facilities may have negative social and economic impacts that are concentrated nearby (Thompson et al., 1993).

Previous research about the economic and social impacts of urban casinos on neighbourhoods has usually been confounded with pathological trends in crime rates and urban blight (Buck et al., 1991; Curran and Scarpitti, 1991; Richards, 1989). For example, Buck et al. (1991) focused on the impacts of a casino on property values in Atlantic City, New Jersey. This study assessed the monetary costs of crime, attributed to casinos, as capitalized in real estate values. The findings of this study were that casinos created positive and negative externalities that balanced in terms of property values. Richards (1989) also studied the effects of the casino industry on employment, taxes, crime and housing in Atlantic City. He concluded that: (1) housing rent levels rose more than twice the level that had existed before casino gambling was introduced; (2) There was a huge increase in crime and the costs of law enforcement; and (3) casinos caused increasing land values to Atlantic city businesses and home-owners. This resulted in higher property taxes, and forced many small property-owners to sell their properties at lower prices because they were unable to pay the higher taxes.

The permanent casino situation in Windsor will vary in many ways from the existing Atlantic City casinos. In Windsor, current plans indicate that there will only be one casino. In comparison, in Atlantic City, the "free-market" casino industry has many casinos stretching over a large area. Second, Atlantic City has traditionally been a tourist-

dependent city (Funnell, 1983). In Windsor, the economy has historically been largely based on the automobile industry. In short, the impacts that a casino will have on the city of Windsor will vary from Atlantic City.

In any case, the phenomenal spread of legal casino gaming across North America outside of Nevada and Atlantic City, N.J., has occurred since the mid-1980s. Also, casinos tended until quite recently to be located in either refurbished urban buildings, or complexes isolated from major population centres. They are now increasingly being housed in purpose-built urban facilities, easily accessible to the consumers, and with extensive non-gaming amenities and attractions (Eadington, 1994). For example, in Windsor, the casino operator has proposed to construct a 6,968 sq. m casino, with a 300-room hotel, at a projected cost of $200 million (Windsor Star (The), 1993, December 6). Also, the City of Windsor has budgeted at least $30 million for land acquisition on the downtown site (Windsor Star (The), 1994, March 23).

2.1 ARIMA Modelling Theory

The underlying theory of this study is that the numbers of property sales, and their prices within the Glengarry neighbourhood, are influenced by (1) the prospect of a permanent casino as expressed in the announcement; (2) the city-wide market's supply and demand conditions; (3) the attributes of the local housing, its lot and its location; (4)

the average of the previous trends in sales and prices; and (5) the random disturbances during one or more previous time periods. In this study, ARIMA (Autoregressive Integrated Moving Average) modelling is utilized to describe the trends in both the numbers of property sales, and the property prices, between 1979 and 1994. An ARIMA model "is an algebraic statement telling how observations on a variable are statistically related to past observations on the same variable" (Pankratz, 1983). This section will describe the necessary theory for diagnosing a best fitting ARIMA model.

An ARIMA model is used to measure the relationships between observations within a series. The basic ARIMA model notation (Pankratz, 1983) for relating a time-series variable (Z_t) to its own past values is:

$$Z_t = C + \phi_1 Z_{t-1} + a_t. \qquad (1)$$

Equation (1) represents the relationship between Z_t and its own immediately past value (Z_{t-1}). C is a constant term. ϕ_1 is a fixed coefficient whose value determines the relationship between Z_t and Z_{t-1}. The terms C, $\phi_1 Z_{t-1}$, and a_t are each components of Z_t. C is a deterministic component, $\phi_1 Z_{t-1}$ is a probabilistic component since its value depends in part on the value of Z_{t-1}, and a_t is a purely probabilistic component (shock element). Together C and $\phi_1 Z_{t-1}$ represent the predictable part of Z_t while a_t is the residual element that cannot be predicted within the ARIMA model.

The first step in diagnosing an ARIMA model is to

determine if the time series is stationary. ARIMA models only apply to stationary data series. A stationary data series has a mean, variance, and autocorrelation function that are essentially constant through time. If the variable in question has a different mean during each time period, it is difficult to get useful estimates of each mean because there is no continuity between observations. However, for a data series that is not stationary, it is usually possible to transform the data series to a stationary one by a process called differencing. Differencing is a relatively simple operation that involves calculating successive changes in values of a data series (w_t). The general notation (Chatfield, 1985) for this process is given by:

$$w_t = z_t - z_{t-1} , \quad t = 2,3,....,n. \tag{2}$$

A nonstationary data series will in most cases become stationary after the "first differences", but if this does not occur, it may be necessary to transform the data into "second differences." The notation (Chatfield, 1985) for this process is represented by:

$$w_t = (z_t - z_{t-1}) - (z_{t-1} - z_{t-2}) , \quad t = 3,4,....,n. \tag{3}$$

The second step in diagnosing an ARIMA model is to determine the structure of the true, underlying mechanism that has given rise to the available data. At this identification stage an estimated autocorrelation function (ACF) and an estimated partial autocorrelation function (PACF) are used to infer the process inherent to the data series. Processes with

past (time-lagged) z terms are called autoregressive (AR) processes, while processes with past (time-lagged) random shocks are called moving-average (MA) processes (Pankratz, 1983).

The ACF calculates a correlation coefficient for each set of ordered pairs (z_t, z_{t+k}) within the series. The ACF measures the direction and strength of the statistical relationship between ordered pairs of observations on two random variables. The symbols $\{r_k\}$ are used to represent the estimated autocorrelation coefficients for observations separated by k time periods within a time series.

The PACF also measures the statistical relationship between each set of ordered pairs (z_t, z_{t+k}) within the series, but it differs in measuring how the ordered pairs are related accounting for intervening z's. For example, the PACF measures the relationship between the ordered pairs (z_t, z_{t+2}) taking into account the effect of z_{t+1} on z_{t+2}. The symbols $\{\phi_{kk}\}$ represents the correlation coefficients for the PACF.

The ACF and the PACF are useful in measuring the relationship between ordered pairs, and the characteristics of these functions are used to indicate the underlying processes in the time series. Autoregressive processes have ACFs that decay toward zero, and PACFs that cut off sharply to zero. Conversely, moving average processes have ACFs that cut off to zero and PACFs that decay toward zero.

The next step in developing an appropriate model is to

determine the order of the process. This is accomplished by inspecting the ACF and the PACF for the longest time lag associated with the most significant correlation coefficient. For example, if the longest time lag attached to a significant correlation coefficient is at z_{t-1}, there would be a process of order 1. Similarly, if the longest time lag attached to a significant correlation coefficient is at z_{t-2}, there would be a process of order 2.

Once the process has been established it is possible to develop the appropriate ARIMA model. In general, an ARIMA model is based on the algebraic statement (Wei, 1990), such as a property's price (for example) at time t, ${}_pZ_t$, being represented as:

$$ {}_pZ_t = (\phi_1 * {}_pZ_{t-1}) + {}_pa_t - (\theta_1 * {}_pa_{t-1}) + (\Sigma_i \ \beta_i X_{Zi}), \qquad (4) $$

or

$$ (1 - \phi_1 B)(1 - B){}_pZ_t = (1 - \theta_1 B){}_pa_t + (\Sigma_i \ \beta_i X_{Zi}); \qquad (5) $$

where ϕ_1 and θ_1 are first-order autoregressive, and moving average coefficients; $\{a_t\}$ are random temporal disturbances from a zero mean white noise process with constant variance σ_a^2; B is the backshift operator $B_j X_{t-j}$; and the $\{\beta_i\}$ are the linear coefficients for weighting the $\{X_{Zi}\}$ attributes of property *Z*. In words, the property prices follow a random temporal process in which a transaction during time period t is a function of its own random disturbance; the price during the previous time period *t-1*, minus θ_1 of the random disturbance at this previous time.

ARIMA modelling is also applicable for this study as it can measure the impact of the casino announcement on property prices and frequencies of sales. An external change in conditions within the housing market during one time period is theorised to be transmitted as a pulse into a neighbourhood during either that, or a later time period. This pulse variable may shift the trend in the numbers of sales and/or the prices either upward, or downward to a new level at which the previously ongoing temporal processes then resume. Thus, the announcement of the permanent casino location may act as a pulse on the numbers of sales and property prices for the two models developed in this study. In general (Wei, 1993), a property price at time t (Z_t) is modelled as:

$$ {}_pZ_t = (\phi_1 * {}_pZ_{t-1}) + {}_pa_t - (\theta_1 * {}_pa_{t-1}) + (\Sigma_i \ \beta_i X_{Zi}) + \omega_0 I_t, \quad (6) $$

or

$$ (1 - \phi_1 B)(1 - B){}_pZ_t = (1 - \theta_1 B){}_pa_t + (\Sigma_i \ \beta_i X_{Zi}) + \omega_0 I_t; \quad (7) $$

where ω_0 represents the impact of the announcement, with I_t being zero until January 1993, and unity thereafter. In words, the property prices follow a random temporal process in which a transaction during time period t is a function of its own random disturbance; the prices during the previous time period t-1, minus θ_1 of the random disturbance at this previous time; plus or minus the pulse, ω_0, from the announcement.

Last, an important application of ARIMA modelling utilized in this study is the forecasting of future values of

(1) monthly property sales and (2) mean monthly property prices for the Glengarry neighbourhood. The forecast is based on past observations in the time series. However, it is recommended that forecasting should be limited to a 'short-term' projection (Pankratz, 1983).

3.0 STUDY AREA

Both the City of Windsor, and the Glengarry neighbourhood, have been relatively stable in population and housing since the mid-1970s. Windsor is a medium-sized city located in Southern Ontario, on the Canada/U.S. border with Detroit. Metropolitan Windsor's population was 260,000 in 1991, and its population growth rate (3.2%) from 1986 to 1991 was below the average (8%) for the 25 CMAs with populations above 100,000 in Canada. Automotive and its allied manufacturing is a dominant source of employment: in the 1986 census, almost one-third of the male labour force 15 years-and-older, and 9% of the female labour force was directly employed in 'processing, machining, product fabricating, assembling and repairing occupations.' Correspondingly, during the late-1980s, the unemployment rate was at least three percentage points above the Canadian average. This uncertainty has depressed the prices of both used and new homes, and the construction of new housing, especially in comparison with those in other Southern Ontario cities nearer to Toronto. These other cities in Ontario's 'golden horse-shoe' resemble those at the upper ends of the urban hierarchy in North America, Britain, and Australia, where inflation in house prices has caused affordability problems for everybody but the established owner-occupiers (Bourne, 1992). Thus, on the one hand, home-buyers in Windsor may have afforded higher proportions of the available housing stock than in other

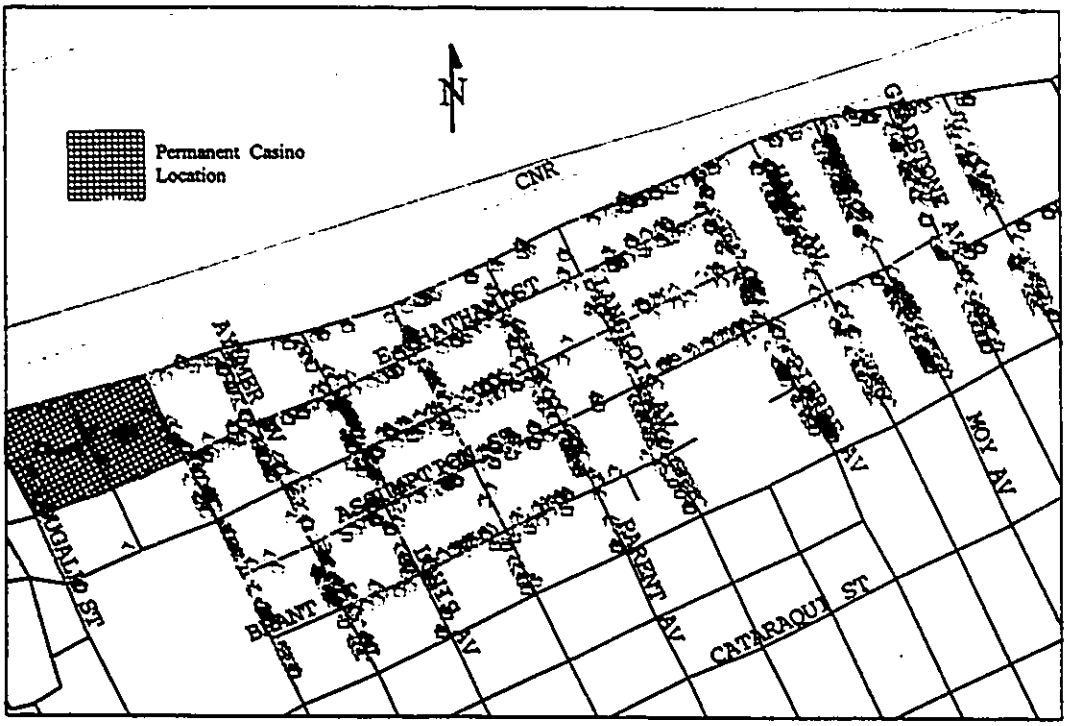
Southern Ontario cities. On the other hand, however, they may have been less assured about their long-term job security, and consequently their ability to pay a mortgage having an unstable interest rate (Rudel and Neagius, 1984).

3.1 Glengarry Neighbourhood

The area of study, which surrounds the permanent casino location, is referred to as the Glengarry neighbourhood (Figure 1). This neighbourhood extends eastward from the downtown along the riverbank of the Detroit River from Ouellette Avenue to Lincoln Road, and a north-south boundary of Riverside Drive and Brant Street.

The planned permanent casino will be located in the western section of the Glengarry neighbourhood. This area is largely composed of commercial and high-density residential uses. The residential dwellings in this area are modest early-twentieth-century homes which had deteriorated both physically and socially until the mid-1970s (Figure 2). Even though two-thirds of the dwellings within the census tract were constructed prior to 1970, one-half of the privately-owned properties within the neighbourhood were rehabilitated with funding from Residential Rehabilitation Assistance Program during the late-1970s ($2 million). During the same period, the Neighbourhood Improvement Program funded above- and below-ground infrastructure improvements within the neighbourhood ($1.2 million). These programs helped to

Figure 1 - Map of the Glengarry Neighbourhood



Glengarry Properties Sold by 3-Year Interval

15 to 18.1	(172)
12 to 15	(303)
9 to 12	(278)
6 to 9	(153)
3 to 6	(265)
0 to 3	(238)

Glengarry Single Detached and Other Types

2 to 5	(260)
0 to 2	(630)

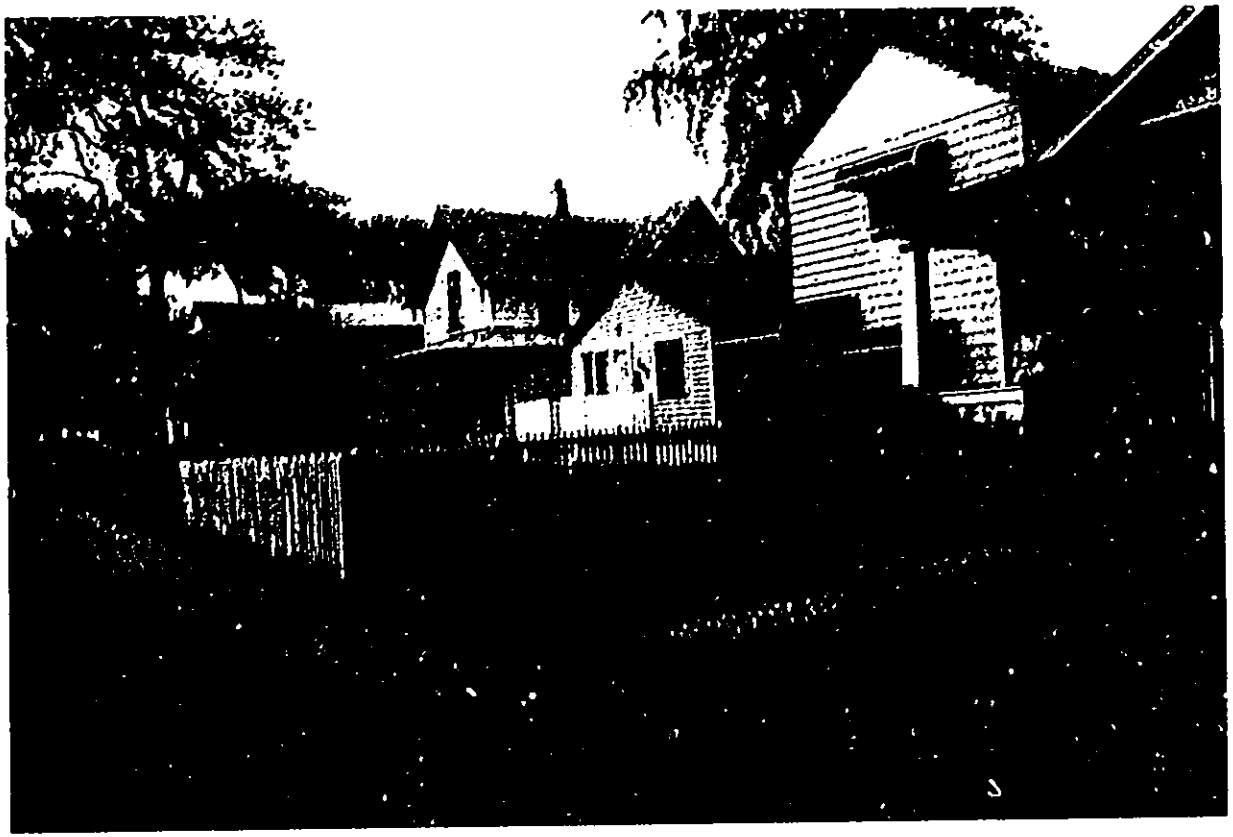


FIGURE 2 - Single Family Dwellings in the Western Section of the Glengarry Neighbourhood

stabilize the social and physical fabric of the neighbourhood. Nonetheless, the housing in this area remains at the lower end of the price scale in Windsor.

This western half of the study area corresponds with one of Windsor's census tracts. During 1991, this census tract had a relatively stable population of 4,400, residing in 2,300 occupied private dwellings. The majority of the tract's dwellings, 59%, were in apartment buildings with five-or-more storeys. These, and most of the additional low-rise apartments, were constructed during an early-1960s phase of urban renewal as geared-to-income housing for senior or low income households (Figures 3 and 4). Correspondingly, during 1991, 81% of the tract's households were renters, 52% were classified as low income, and 33% of the families were headed by a lone parent.

In contrast, the eastern section of the Glengarry neighbourhood contains well-maintained, brick houses, originating from the early-twentieth-century distillery town of Walkerville (Figure 5). Although the houses in this area were essentially built during the same period as those in western section, their physical fabric has remained in better condition.

FIGURE 3 - Apartment Buildings in the Western Section of the Glengarry Neighbourhood

FIGURE 4 - Geared-In-Come, Low-Rise Apartments in the Western Section of the Glengarry Neighbourhood

FIGURE 5 - Early-Twentieth-Century Dwelling on the Eastern Section of the Glengarry Neighbourhood

3.2 Permanent Casino Site

The permanent casino site covers four square blocks of the downtown area, bordered by McDougall Avenue, Glengarry Avenue, Chatham Street, and Riverside Drive. This site is an under-utilized area that is currently occupied by various office buildings, commercial structures, residential dwellings and parking lots (Figures 6 and 7). The permanent casino site is currently zoned for commercial use. However, it is located where the local zoning moves from a commercial to a residential designation. To the immediate south and west of the permanent casino site, the area is designated for commercial uses. The residential zoning is located to the immediate east of the site. Home-owners located in close proximity have mixed feelings about the selection of the site of the permanent casino (Windsor Star (The), 1993, January 15). Some home-owners are excited over the possibility of higher land values, where as others are worried about the "expected" alterations to the fabric of their neighbourhood (Windsor Star (The), 1993, January 15).

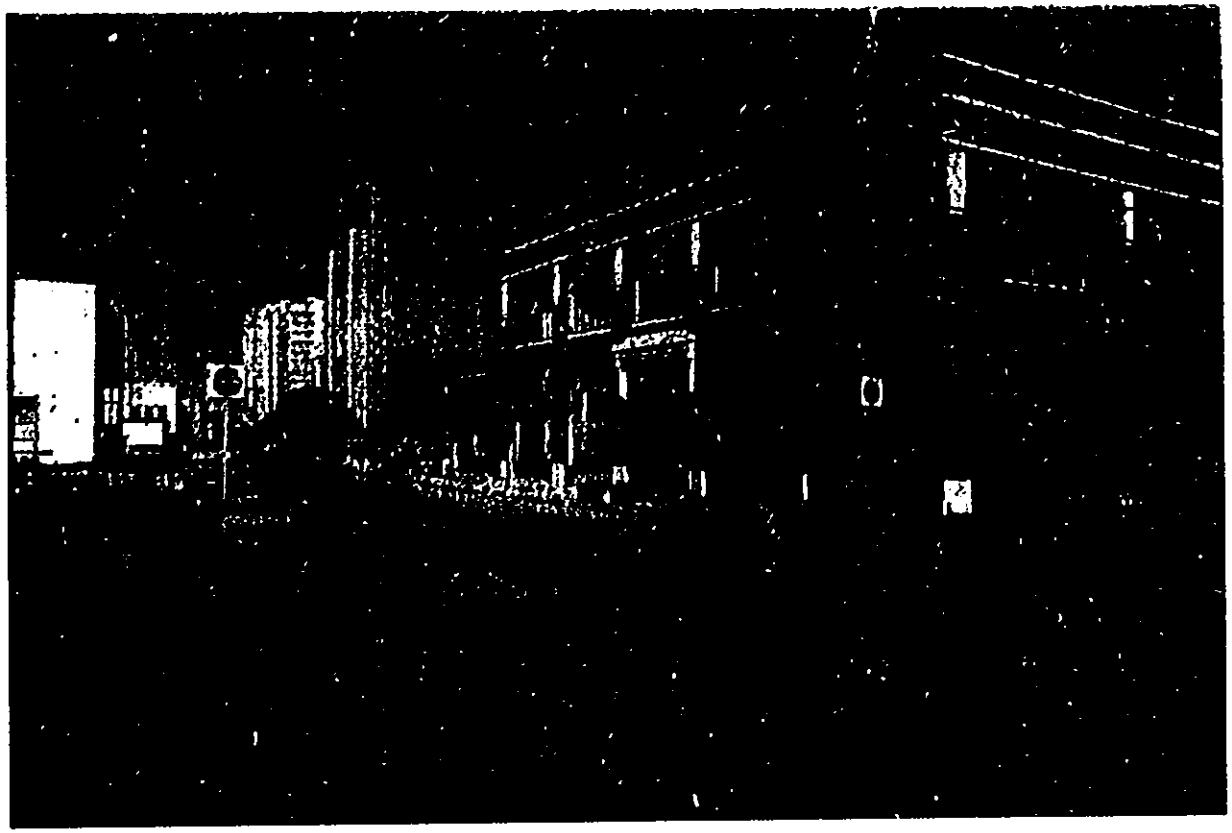


FIGURE 6 - Commercial Building Located on the Permanent Casino Site

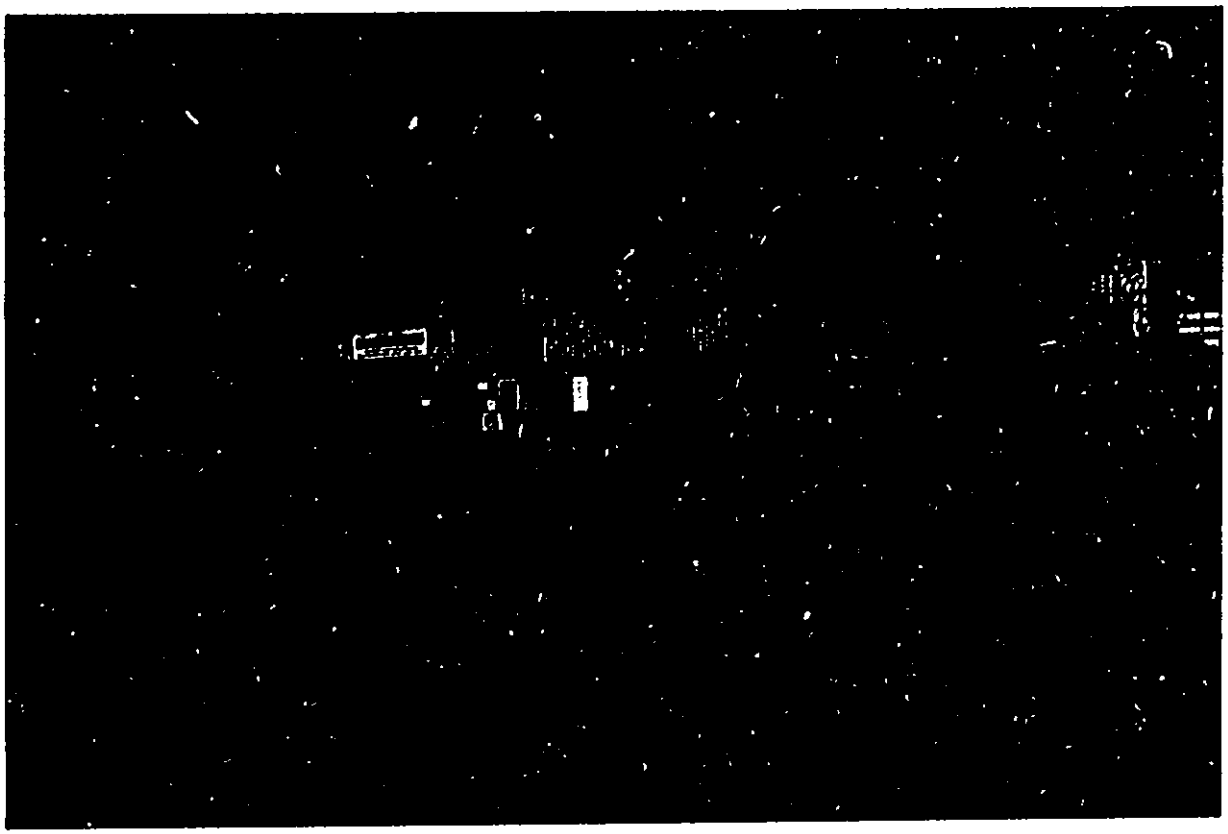


FIGURE 7 - Commercial Building Located on the Permanent Casino Site

4.0 DATA

Two data sets are utilized in this study. The first data set is composed of 1,344 residential and 65 commercial sales of 608 properties within the Glengarry neighbourhood during the 18-year period from the beginning of 1975 to the end of 1993. The year, 1975, was selected as the beginning of the study period because of data set limitations. The data for each transaction were from *Teela* real estate records. This information is published on a monthly basis by *Teela Management Systems*, a division of *Moore Corporation Limited*. *Teela* real estate records list the date of the sale, the street address and number, the price, the lot-size, the name of the purchaser, and the residential or commercial designation of the property.

The second data set is composed of the numbers of monthly housing sales, and the average monthly residential sale prices for houses located in Windsor and Essex County between January 1979 and April 1994. These data were collected by the *Windsor-Essex Real Estate Board* and assembled by the *Canada Mortgage and Housing Corporation*. The Windsor/Essex County housing data are used to compare the property sales and prices within the study area with those in the entire county.

The property prices used in the analysis are deflated to 1975 dollars, assuming an average annual increase in the Canadian consumer price index for housing of 4.75% from the beginning of the study period (This average deflation was

calculated as a geometric mean of the tabulated housing c.p.i.s. for Canada). The straight-line distances from the locations of each sold property to the centre of the permanent casino were computed in order to control for location in the ARIMA model.

5.0 METHODOLOGY and RESULTS

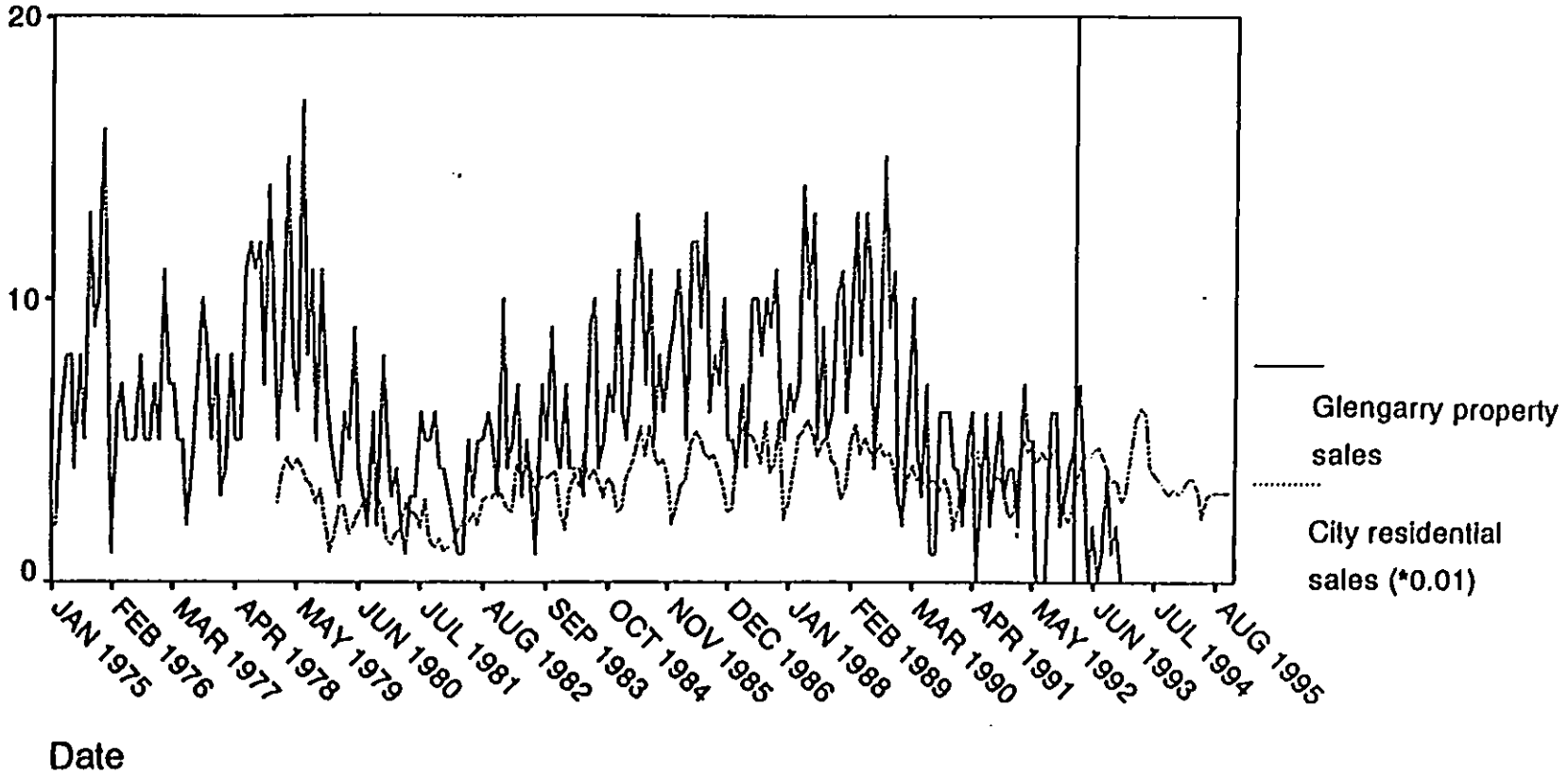
5.1 Monthly Property Sales

As Figure 8 shows, the numbers of monthly property sales within the Glengarry neighbourhood (solid line) and Windsor/Essex County (dotted line) have essentially maintained a similar pattern, with the exception of the last eight months in 1993. The numbers of property sales for both the Windsor/Essex County and the Glengarry neighbourhood have grown from troughs in 1981 and 1982, up to peaks in 1988 and 1989. However, since the peaks in 1988 and 1989, the numbers of property sales within Windsor/Essex County and the Glengarry neighbourhood have followed different trajectories. Since 1989, monthly property sales within Windsor/Essex County have risen to their highest levels for the study period (1979-1993), while during this same time, the frequencies of sales within the Glengarry neighbourhood has slumped to their lowest levels. For example, during the 1975-93 period, the average monthly number of sales in the Glengarry neighbourhood was 6.2 (+/- one standard deviation, 3.4). However, during the year following the announcement of the permanent casino site, the mean number of monthly sales decreased to 2.2, with three of the twelve months having zero transactions.

In comparison, during the 1979-93 period, the average monthly number of sales in Windsor/Essex County was 355 (+/- one standard deviation, 24). During 1993, the average monthly number of sales increased from 355 to 418. These different

Figure 8. Monthly Property Sales

Glengarry vs. Windsor/Essex Co.



trends in numbers of property sales between Windsor/Essex County and the Glengarry neighbourhood indicate that there were varying social and/or economic forces affecting the study area in 1993. One possibility is that the announcement of the permanent casino location resulted in a decrease in property sales in the Glengarry neighbourhood.

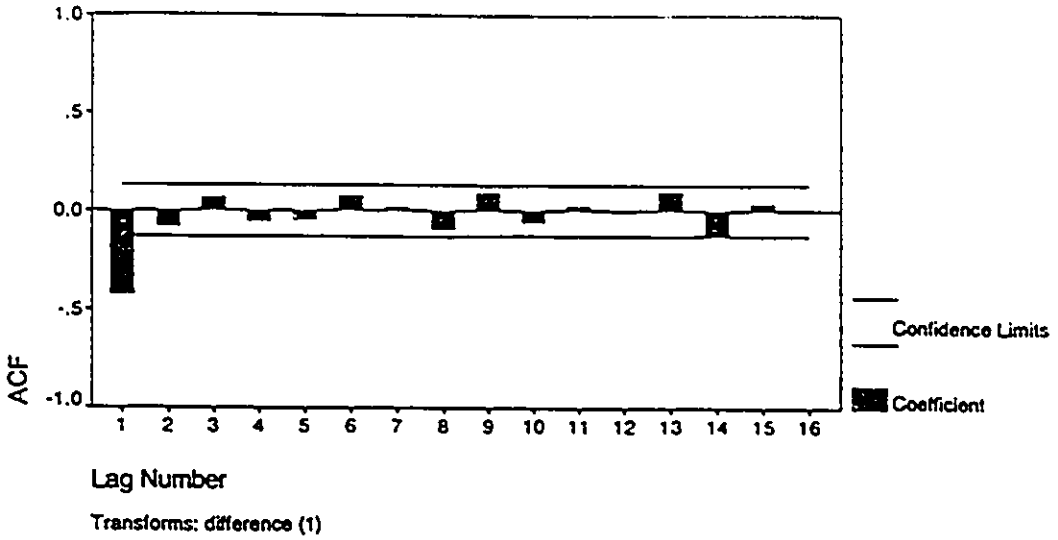
From the graphic plots of the monthly property sales in Figure 8, it was determined that the data series had non-stationary means. Accordingly, the data series was "differenced" in order to transform the series into a stationary data set. After once-differencing, the autocorrelation and partial autocorrelation functions for the monthly property sales were calculated and are displayed in Figures 9 and 10. The distributions of the correlations in these functions, with the statistically-significant lag-one correlation $\rho_1 = -0.43$ ($\alpha < 0.05$), and the partial autocorrelations decaying exponentially from $\phi_{1k} = -0.43$, diagnosed the time series as the product of a first-order moving average (MA(1)) process. The diagnosis of a MA(1) process indicated that the appropriate ARIMA model for the monthly sales frequencies had the general form:

$$(1 - B)Z_t = (1 - \theta_1 B)_p a_t + (1 - B)W_t + \omega_0 I_t; \qquad (8)$$

where Z_t is the Glengarry monthly number of sales, and W_t is Windsor/Essex County monthly number of sales. This ARIMA(0,1,1) model was then used (1) to calculate the statistical relationships between sales in the Glengarry

Figure 9. Glengarry Monthly Property Sales

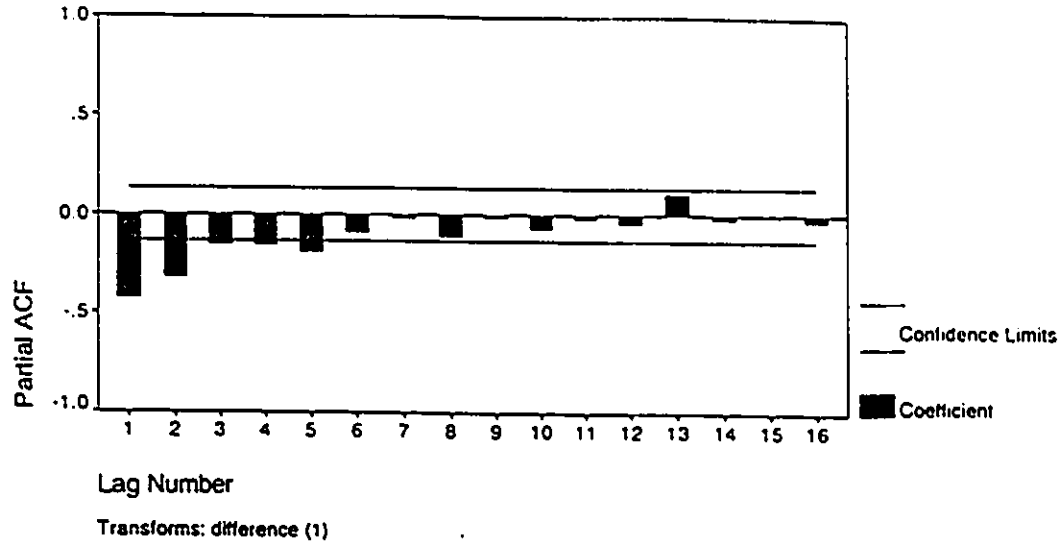
Autocorrelations



Transforms: difference (1)

Figure 10. Glengarry Monthly Property Sales

Partial Autocorrelations



Transforms: difference (1)

neighbourhood and in Windsor/Essex County, (2) to measure the impact of the casino location announcement on property sales, and (3) to forecast the monthly sales for a 24 month period.

The ACF and the PACF diagnosed the time series as the product of a first-order moving average (MA(1)) process. On the basis of the highly statistically significant MA(1) coefficient for the calibrated ARIMA(0,1,1) model ($\theta_1 = 0.84$; $\alpha < 0.000$), the B coefficients for Windsor/Essex County monthly sales numbers (W_t), and for the pulse variable for the timing of the casino location announcement, the number of sales at time t (Z_t), as shown in Table 1, is modelled by:

$$(1 - B)Z_t = (1 - 0.84B)a_t - 0.74I_t + (1 - 0.92B)W_t. \quad (9)$$

In words, first, the number of sales follow a moving average temporal process in which these during time period t are a function of their own random disturbance, the number during the previous time period t-1, minus 84% of the random disturbance at this previous time. Second, the announcement of the casino location during January 1993 was associated with a decline in numbers of sales afterward; there was almost a loss of 3/4's of a sale from a month before, to a month after. Nonetheless, this result is quite tentative, as the t statistic for the coefficient is not statistically significant, possibly owing to the small number of observed property sales after the casino announcement. Third, there was a very strong correlation ($\theta_1 = 0.92$; $\alpha < 0.001$) between the number of sales in Windsor/Essex County and the number of

Table 1. ARIMA(0,1,1) of Monthly Property Sales in Glengarry 1979-93.

Goodness of Fit	
Number of residuals	179
Standard error of estimate	2.8
Log likelihood	-434.9
Akaike's Information criterion	875.9
Schwartz's Bayesian criterion	885.4

Analysis of Variance	DF	Adjusted Sum of Squares	Residual Variance
Residuals	176	1351.5	7.63

Variables in the Model	$\bar{x}$[1]	95% C.I.[2]	β[3]	S. E β[4]	T-Ratio[5]	α[6]
MA(1), First Order Moving Average			0.84	0.04	20.7	0.000
Monthly Residential Sales in Windsor/Essex Co (*0.01)	3.55	0.16	0.92	0.24	3.83	0.001
Casino Location Announcement (0 = 'before Jan. 1993'; 1 = 'after Jan. 1993')			-0.74	1.52	-0.48	0.63

1. Variable mean score.
2. +/-95% confidence interval.
3. Slope coefficient.
4. Standard error of slope coefficient.
5. Computed T-ratio for slope coefficient.
6. Significance level.

sales within the Glengarry neighbourhood. The model suggests that for every change of 100 monthly sales in Windsor/Essex County, there is an associated change in almost one sale in the Glengarry neighbourhood.

To further investigate the relationship between numbers of sales in the Glengarry neighbourhood and Windsor/Essex County, a cross correlation function was calculated. The cross correlation function indicates the statistically-significant timing of the correlation as well as the strength of the relationship. The notation for the cross correlation function (Chatfield, 1985) is represented as:

$$\rho_{xy}(k) = (\tilde{\gamma}_{xy}(k)) / (\sigma_x \sigma_y); \qquad (10)$$

where k is the lag, σ_x and σ_y are the standard deviations of x_t and y_t, and $\tilde{\gamma}_{xy}(k)$ is the cross-covariance function. In this case x is the monthly sales frequencies for the Glengarry neighbourhood, and y is the monthly property sales for Windsor/Essex County. The strong correlation between the monthly sales numbers for the County and the Glengarry neighbourhood is further substantiated by the cross correlation function, with the statistically-significant lag-zero correlation $\rho_0 = 0.21$ ($\alpha < 0.05$) in Figure 11.

Figure 12 superimposes (1) the predicted monthly property sales from the calibrated ARIMA model, (2) the actual number of Glengarry property sales for the past 228 months, and (3) the forecasts of the numbers of sales for the following 24 months based on the past trends. (A vertical line on the

Figure 11. Monthly Property Sales

Glengarry vs. Windsor/Essex Co. Cross Correlations

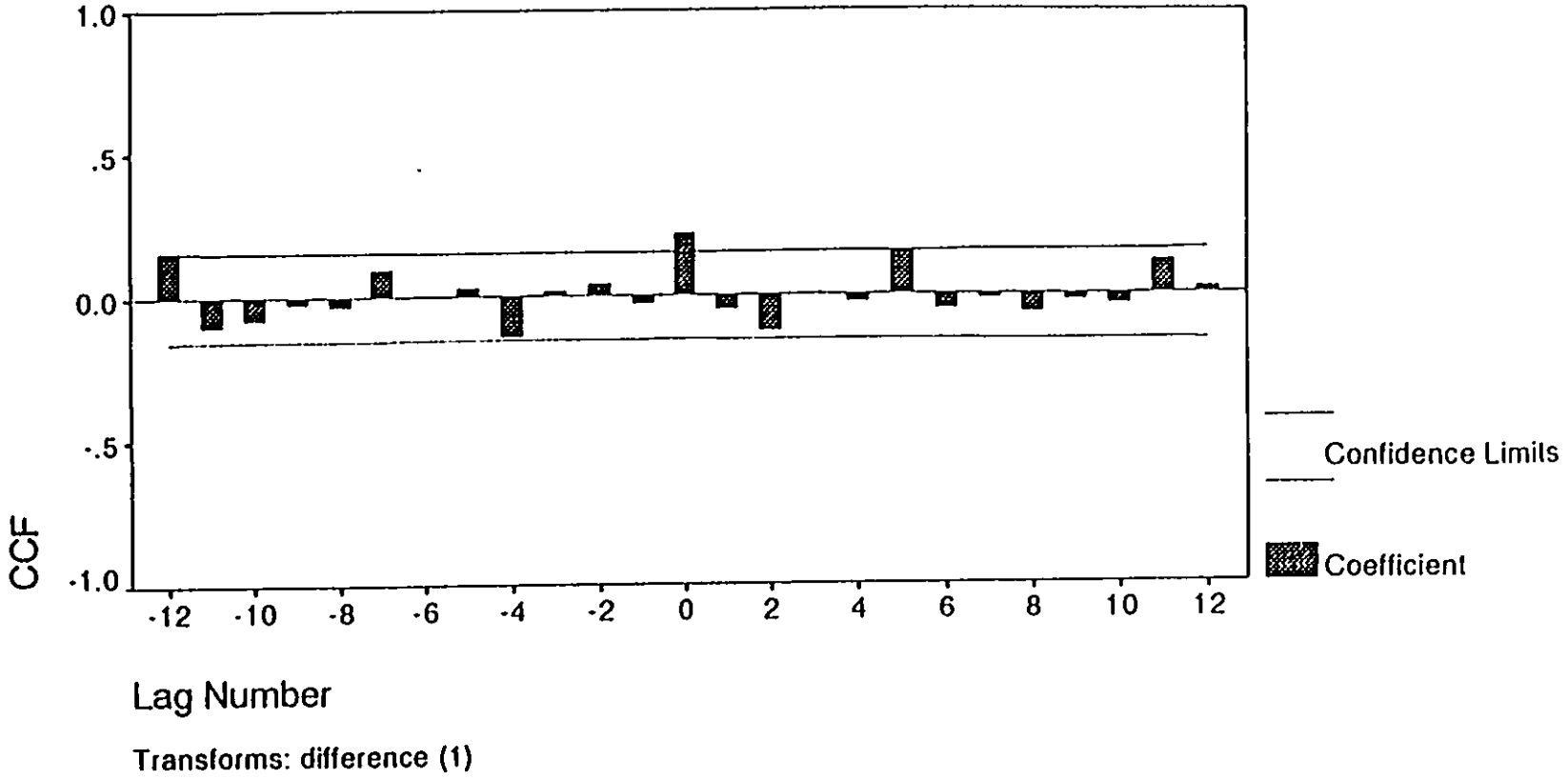
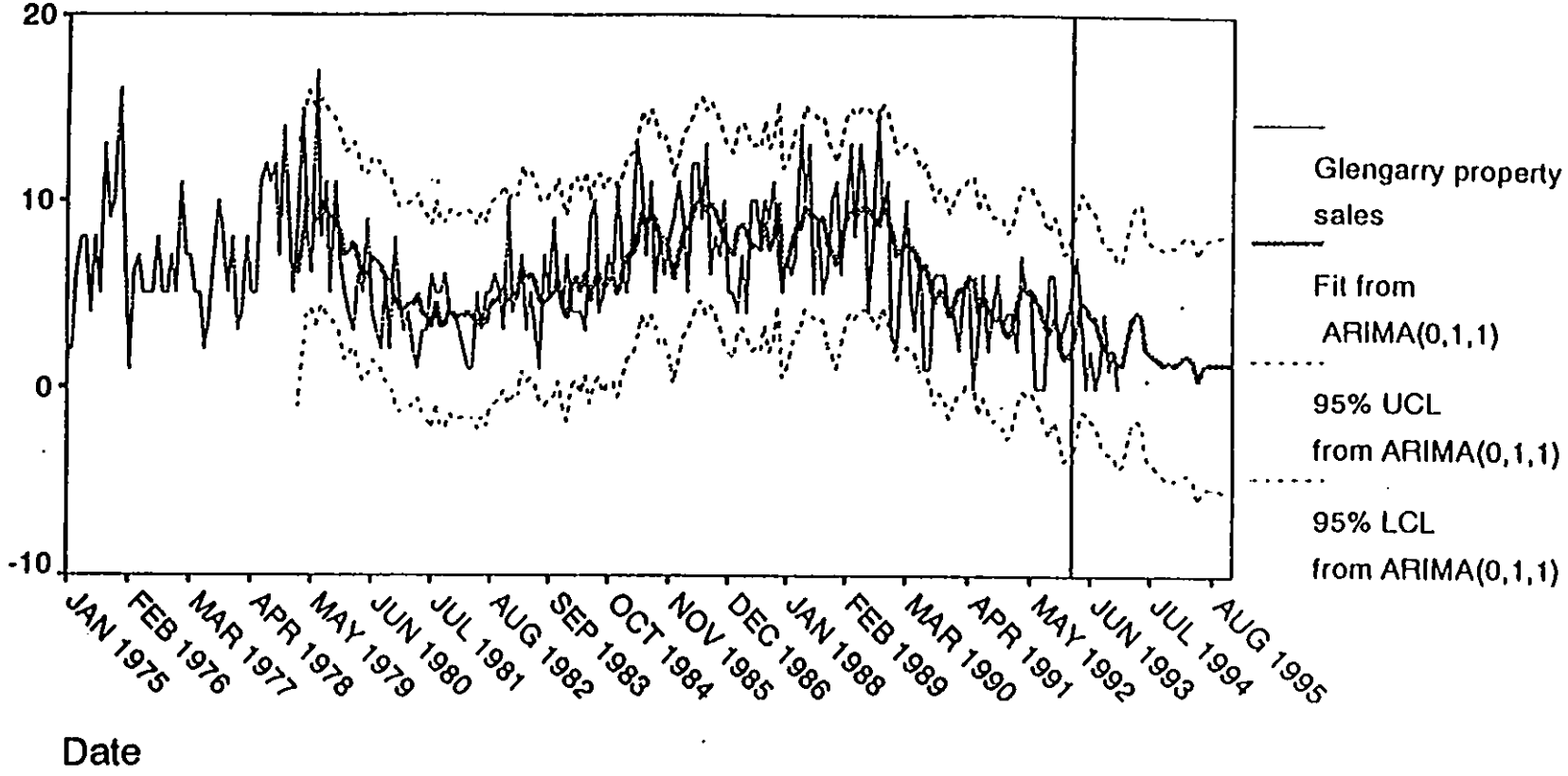


Figure 12. Glengarry Actual and Predicted Monthly Property Sales



right of the figure denotes the timing of the casino announcement.) As the first-order moving average process is based on the impulse of the most recent random disturbance, and relatively few transactions had occurred since 1993, the forecast for the monthly numbers of property sales in the Glengarry neighbourhood for the next 24 months is extremely low, on average less than two sales per upcoming month. In other words, the housing market in the Glengarry neighbourhood is forecast to remain relatively inactive during the years 1994 and 1995 in the absence of a permanent casino. The possibility of comparably low property prices being either a cause or a result of this inactivity, with owners holding onto their property, rather than disposing of it, is explored in the next section.

5.2 Mean Monthly Property Prices

The mean monthly property prices for the Glengarry neighbourhood and Windsor/Essex County were graphically plotted to obtain simple descriptive measures of the two series. Nine outlier sales were discarded owing to their lot size greater than 12,000 sq. ft. and their prices greater than $500,000. The log-transformed, deflated price series required a once-difference transformation to stabilize its variance and its mean through time. A comparison of the mean monthly property prices for Windsor/Essex County and the Glengarry neighbourhood was that, as Figures 13 and 14 show, the mean

Figure 13. Mean Monthly Property Prices
Glengarry vs. Windsor/Essex County

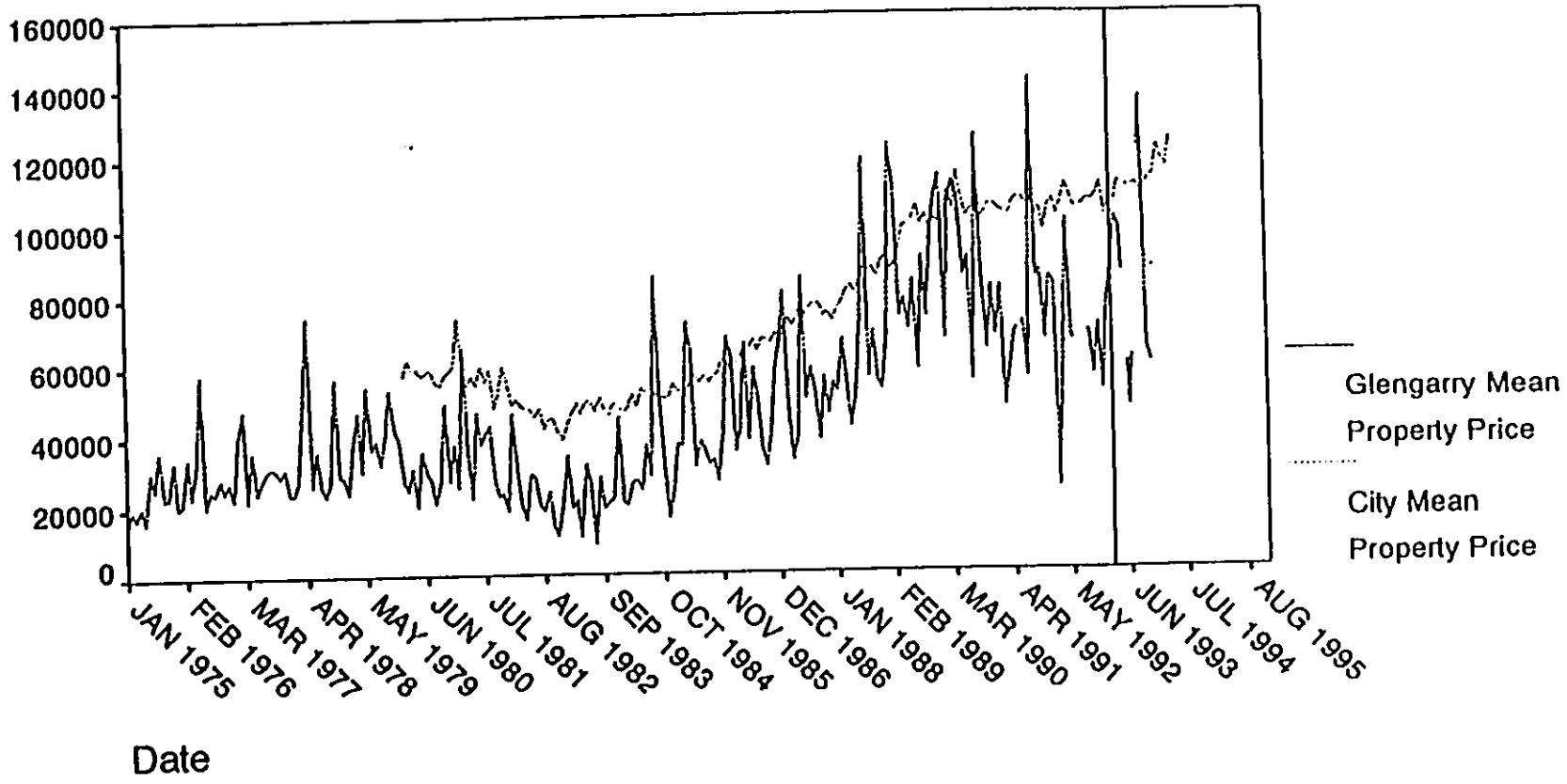
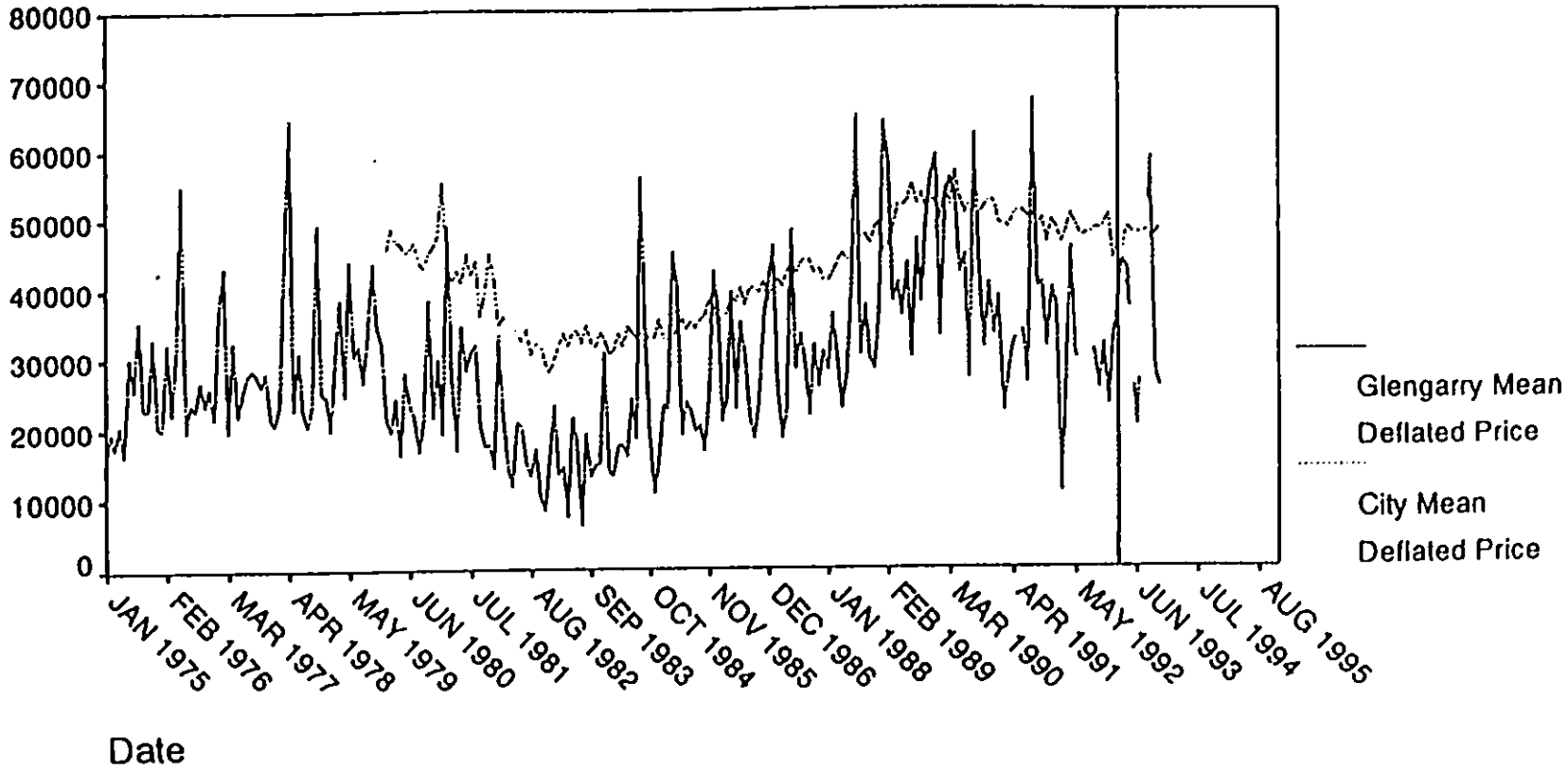


Figure 14. Mean Monthly Deflated Property Prices
Glengarry vs. Windsor/Essex County



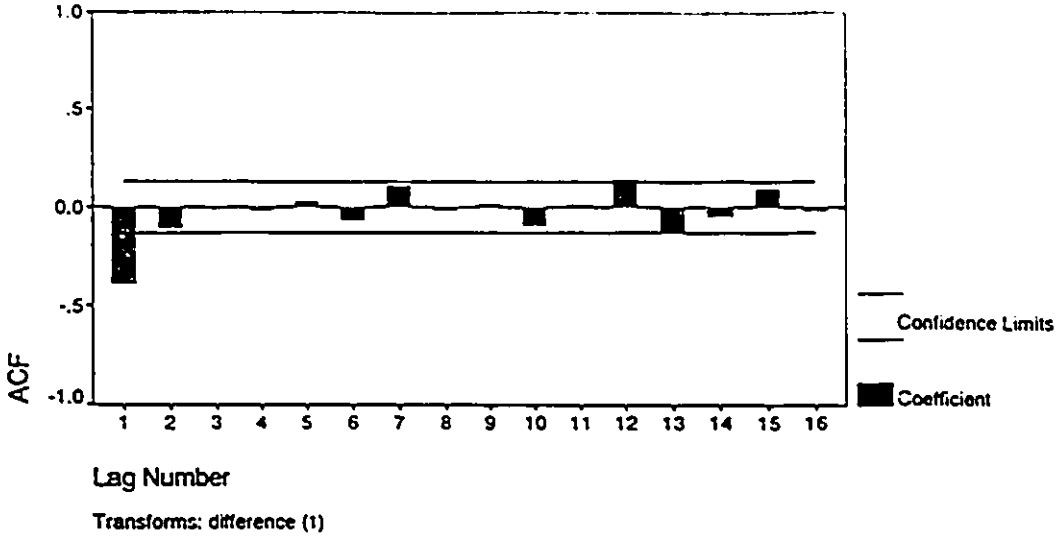
monthly property prices within the study area and Windsor/Essex County have essentially maintained a similar decline-and-growth pattern, with the exception of the years from 1991 to 1994. The mean monthly property prices, for both Windsor/Essex County and the Glengarry neighbourhood steadily decreased from 1979 until 1983 when they begin to consistently increase. However, since 1990, the mean monthly property prices within Windsor/Essex County and the Glengarry neighbourhood have diverged. Since 1990, the mean monthly property prices within Windsor/Essex County have continued to increase, whereas the property prices within the Glengarry neighbourhood have decreased from 1990 until 1993 when the prices began to turn around.

Figure 14 also shows the deviation in property prices between Windsor/Essex County and the Glengarry neighbourhood, with the mean monthly property prices for Windsor/Essex County being consistently over $30,000 greater than those properties sold within the Glengarry neighbourhood. It is also important to note that, owing to the fewer numbers of properties in the Glengarry housing data set, the variations in the mean monthly property prices for the Glengarry neighbourhood are more exaggerated than those representing Windsor/Essex County.

The autocorrelation and partial autocorrelation functions for the mean monthly property prices are displayed in Figures 15 and 16. The distributions of the correlations in these functions, with the statistically-significant lag-one

Figure 15. Glengarry Mean Monthly Property Prices

Autocorrelations

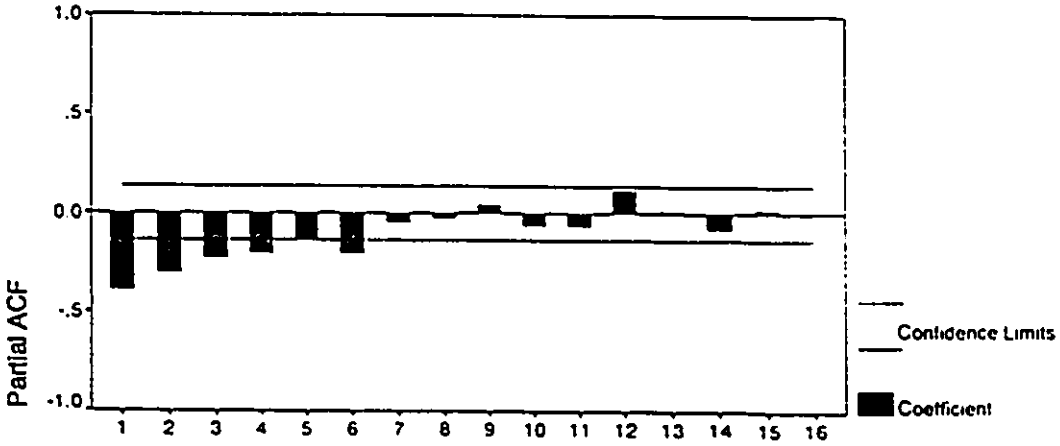


Lag Number

Transforms: difference (1)

Figure 16. Glengarry Mean Monthly Property Prices

Partial Autocorrelations



Lag Number

Transforms: difference (1)

correlation $\rho_1 = -0.39$ ($\alpha < 0.05$), and the partial autocorrelations decaying exponentially from $\phi_{1k} = -0.39$, diagnosed the time series as the product of a first-order moving average (MA(1)) process. The general model for the mean monthly property prices is therfore:

$$(1 - B)_p Z_t = (1 - \theta_1 B)_p a_t + (1 - B)_p W_t + \omega_0 I_t + D_{ZJ} + L_Z; \quad (11)$$

where Z_t is the Glengarry mean monthly property price, W_t is Windsor/Essex County mean monthly property price, D_{ZJ} is the average distance from the properties sold in a month to the casino site in Kilometres, and L_Z is the average lot size of the properties sold monthly (in thousands of sq. ft.). This ARIMA(0,1,1) model was then used to: (1) calculate the statistical relationships between the mean monthly property prices in the Glengarry neighbourhood and in Windsor/Essex County; and (2) to measure the impact of the casino location announcement on the property prices in the Glengarry neighbourhood. The actual ARIMA(0,1,1) model, as shown in Table 2, has the coefficients for the properties' LN deflated prices at time t, ${}_pZ_t$:

$$(1 - B)_p Z_t = (1 - 0.90B)_p a_t + 0.11 I_t + 0.35 D_{ZJ} + 0.13 L_Z + (1 - 1.37B) W_t \ . \quad (12)$$

Four of the five ARIMA coefficients are statistically significant, but the one for the pulse variable is not. First, the ARIMA(0,1,1) model indicates that the property prices follow a moving average temporal process in which a property value during time period t is a function of its own

Table 2. ARIMA(0,1,1) of LN Deflated Monthly Mean Property Prices in Glengarry 1980-93.

Goodness of Fit	
Number of residuals	159
Standard error of estimate	0.34
Log likelihood	-50.6
Akaike's Information criterion	111.2
Schwartz's Bayesian criterion	126.5

Analysis of Variance	DF	Adjusted Sum of Squares	Residual Variance
Residuals	154	17.6	0.11

Variables in the Model	ϗ	95% C.I.	β	S. E β	T-Ratio	α
MA(1), First Order Moving Average			0.90	0.04	24.2	0.000
Ln Deflated Monthly Mean Residential Prices in Windsor/Essex Co.	10.66	0.02	1.37	0.32	4.2	0.000
Monthly Mean Property Lot Size (000s sq. ft.)	3.96	0.14	0.13	0.04	3.3	0.001
Monthly Mean Distance between Property and Casino Site (km)	0.67	0.02	0.35	0.14	2.4	0.02
Casino Location Announcement (0 = 'before Jan. 1993'; 1 = 'after Jan. 1993')			0.11	0.17	0.7	0.51

random disturbance, the mean deflated price during the previous time period t-1, minus 90% of the random disturbance at this previous time. In other words, the property prices during each time period t-1 strongly determine prices during the next time period t.

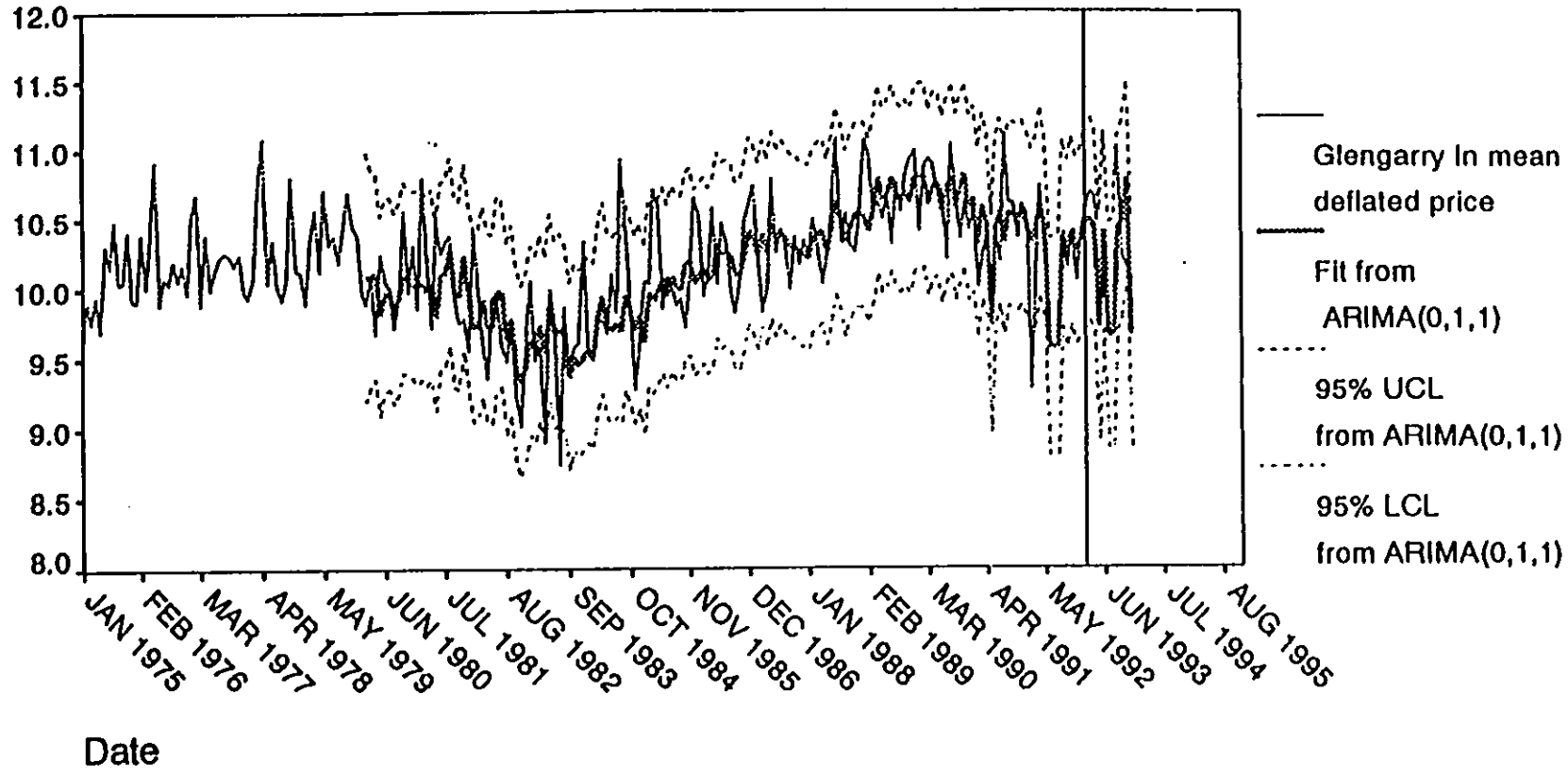
Second, average property prices are positive functions of increasing average lot size (L_z), and greater average distance (D_{zJ}) from the site of the permanent casino. As expected; (1) a larger lot size usually creates a higher property value in a homogeneous residential neighbourhood; and (2) as described in Section 3.1, the higher quality housing within the study area is located the greatest distance to the east from the permanent casino location.

Third, the mean monthly property prices in Windsor/Essex County and in the Glengarry neighbourhood are highly correlated. The model suggests that for every average price change of $1,000 in Windsor/Essex County from one month to the next, there is corresponding change in the Glengarry neighbourhood of $1,370 per home. This exaggeration is a result of the lower number of properties located within the study area and the fact that one or two sales per month in the Glengarry neighbourhood inflate, or deflate, the average for the month.

Fourth, the announcement (I_t) of the casino location was weakly associated with a property price rise, as the coefficient is positive but not significant. The model

suggests that, aft : the casino location designation, the average property prices within the study area have increased by approximately 11%. Nonetheless, this result is quite tentative, as the t statistic for the coefficient is not statistically significant, possibly owing to the small number of observed property sales after the casino location announcement. Figure 17 superimposes the predicted mean monthly property prices from this ARIMA model against the actual number of Glengarry property sales for the past 228 months (a vertical line on the right of the figure denotes the timing of the casino announcement). Figure 17 illustrates the "wild" fluctuations in the mean monthly property prices in the Glengarry neighbourhood during the last 24 months. As stated earlier, these fluctuations are possibly a result of the small number of observed property sales during this period.

Figure 17. Glengarry Actual vs. Predicted LN Mean Monthly Deflated Property Prices



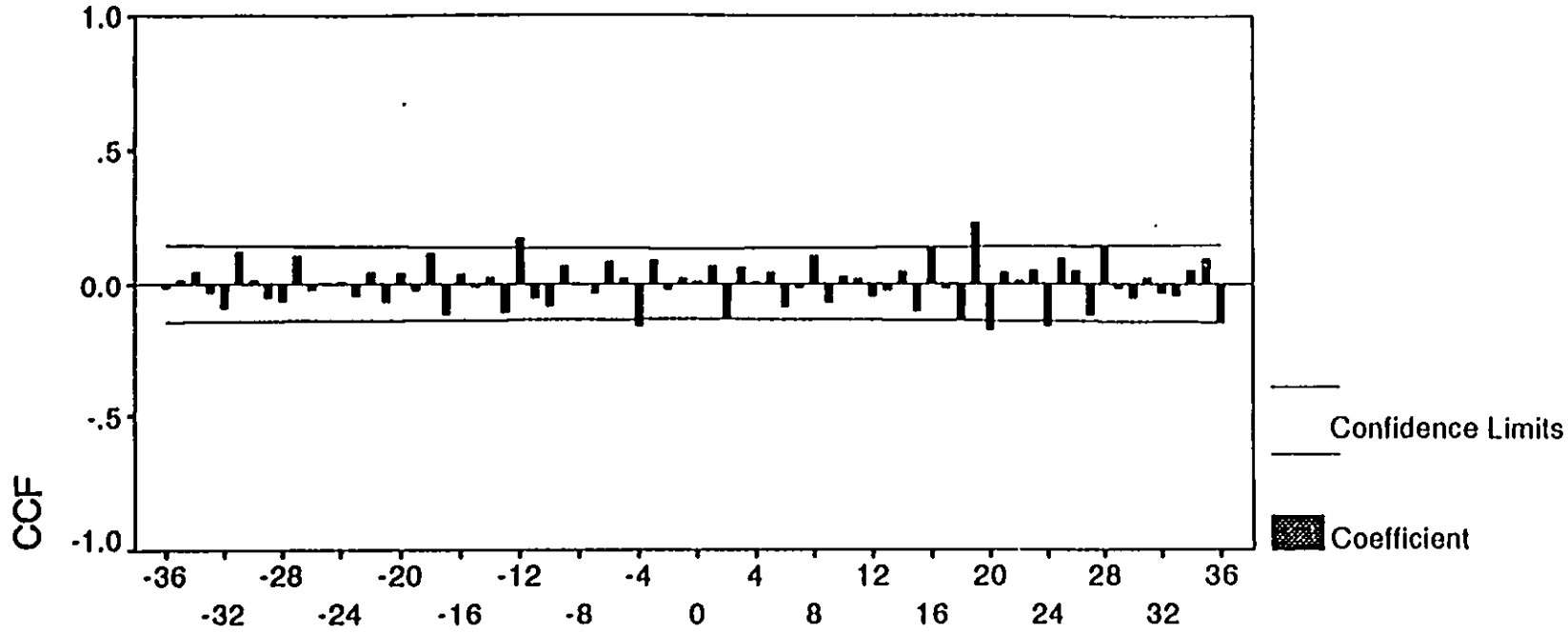
5.3 Property Sales and Property Prices

Even though both the monthly property sales and the individual deflated property prices in the Glengarry neighbourhood are modelled as moving average processes, they in fact are only weakly related to each other by one leading or lagging the other. A cross correlation between the monthly property sales and the mean monthly property prices for the Glengarry neighbourhood determined the timing and the strength of the relationship between the sales and price trends. The notation for the cross correlation function (Chatfield, 1985) is represented as:

$$\rho_{xy}(k) = (\tilde{\iota}_{xy}(k)) / (\sigma_x \sigma_Y); \qquad (13)$$

where k is the lag, σ_x and σ_Y are the standard deviations of x_t and y_t, and $\tilde{\iota}_{xy}(k)$ is the cross-covariance function. In this case x is the monthly transaction frequencies and y is the mean monthly property prices. The cross correlations, $\rho_{z,pz}(k)$, for up to 36 lags forward and backward are uniformly low between the monthly property sales and the mean monthly deflated property prices (i.e., for k = +/- 36 months) (Figure 18). The first significant cross correlation ($\alpha < 0.05$) is at lag 19 ($\rho_{z,pz}(19) = 0.23$), and this suggests that property prices respond to a trend in the number of sales approximately one and a half years later. In other words, when there is an increase in the number of sales, 19 months later, there is a response of an increase in property prices, or vice versa.

Figure 18. Glengarry Mean Monthly Property Prices vs. Monthly Sales



5.4 Property Ownership

An emerging inference from the foregoing ARIMA models is that the property market in the Glengarry neighbourhood has been moving randomly and disaggregately during the 1975-93 period. This is further corroborated by a frequency count of the names of the property purchasers. Simple frequencies of purchaser names were conducted to measure the numbers of properties owned by certain individuals or companies. The frequency tabulation was conducted by sorting the first-eight characters of the purchaser names. This tabulation of the purchaser names indicates that different individuals or companies bought 69% of the properties. Individuals or companies having the same 'name', and buying two properties, were involved in 18% of the sales, and those buying three or more, 13%. However, an investigation into the concentration in final ownership of property within the Glengarry neighbourhood indicated that there were three owners who had significant concentrations of holdings. As of December 1993, one land-owner possessed six properties, encompassing an entire city-block of land approximately two blocks from the location of the permanent casino site. This represents the largest holding of land within the Glengarry neighbourhood. A second land-owner also possessed six properties within the Glengarry neighbourhood. This owner's six properties were located along an entire city-block approximately three blocks from the location of the permanent site. A third land-owner

with a concentration of property within the Glengarry neighbourhood, possessed three lots approximately four blocks from the site of the permanent casino location. Of the fifteen properties currently owned by the three significant owners, 80% of these properties were purchased before 1983. The remaining 20% were all purchased during the year of 1987. Therefore, the most recent purchase was more than five years prior to the announcement of the permanent casino site.

6.0 CONCLUSIONS

This study has measured, and modelled trends in property within the Glengarry neighbourhood before the planned opening of a nearby permanent casino during 1996. Three measurements of property alteration were analyzed: (1) the monthly numbers of residential and commercial property sales; (2) the sale prices of these properties; and (3) the identification of the purchasers. The time series modelling indicated that the numbers of property sales, and their deflated property prices had not responded statistically significantly to the announcement of the permanent casino location. However, the ARIMA analyses including a pulse variable for the timing of the announcement were contradictory, as prices slightly increased after the permanent casino site selection, while the numbers of sales within the study area were at their lowest levels of the fourteen year study period. The ARIMA analyses indicated a decline in sales "as a result" of the permanent casino location announcement. Also, whereas the Glengarry neighbourhood experienced its lowest levels of property sales, Windsor/Essex County sales were at their highest numbers during the study period. These trends might be consistent with (1) the home-owners within the Glengarry neighbourhood waiting for the real estate prices to inflate after the construction of the permanent casino begins, and/or (2) buyers waiting for the construction of the permanent casino to begin. Buyers may be wary that there will never be a casino

constructed on that site. This has become even more of a concern as a result of a referendum vote in the City of Detroit, where there was approval to construct a casino in that city. The construction of the Windsor casino may not be viable if there is a casino in Detroit. In the absence of the permanent Windsor casino, the ARIMA models utilized in this study have forecast (1) relatively low monthly numbers of property sales, and (2) stable property prices, for 1994 and 1995.

The tabulation of the names of purchasers during the recent past further substantiated the claim that land assembly and speculation has not began as a result of the announcement of the permanent casino site. While there are owners with significant land holdings within the Glengarry neighbourhood, their accumulation of these properties is not be related to the timing of the permanent casino designation. In conclusion, this study has thus far not identified changes in numbers of sales, property values, and purchaser-concentration within the Glengarry neighbourhood that signify the beginnings of property re-evaluation and land-use alteration associated with the announcement of the location of an urban casino.

The relationship between property values and nonconforming land uses is of interest to urban planners and city officials. In public hearings, concerning municipal planning, local residents are often concerned with the relationship between nonconforming land uses and the potential

for visual intrusion, increased traffic congestion, and other negative externalities. Such public debates are frequently fuelled more by emotion and misinformation than by statistical evidence. With the likelihood of the construction of casinos in other Ontario cities, the statistical evidence provided in this research may aid in the selection of suitable casino sites in the future.

Since this was a baseline study, future research may follow the same methodology for the years beyond 1993. Trends in monthly sales and property prices may change between (1) the period from the announcement of the casino site to the final construction of the permanent casino, and (2) the period after the construction of the permanent casino. The physical construction of the permanent casino may alleviate the doubt of property buyers who are sceptical that the casino will be located at the proposed site. This demand for property around the permanent casino may significantly change the trends in property prices and sales in the Glengarry neighbourhood.

Future research may also extend this study by adding independent variables that determine property sales or price. In this study, the independent price determining variable were lot size, distance from the permanent casino site, and the Windsor/Essex County sales. In the future, the collection of each property's physical attributes and the social attributes of the neighbourhood may enhance the modelling process.

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